SEASONAL MICROHABITAT RELATIONSHIPS OF BLUE GROUSE IN SOUTHEASTERN IDAHO

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ABSTRACT.—Microhabitat characteristics of blue grouse (*Dendragapus obscurus*) were analyzed in breeding and wintering habitats in southeastern Idaho. Breeding habitats typically were open sagebrush (*Artemisia* spp.), mixed shrub, mountain mahogany (*Cercocarpus ledifolius*), and maple (*Acer grandidentatum*) stands on east to south facing aspects of slopes below 2100 m elevation. Breeding blue grouse selected areas with approximately a 50:50 or greater open to cover ratio. Blue grouse selected areas with higher tree coverage than available on average within the mixed shrub vegetation type. Hens with broods preferred sites with relatively tall (>50 cm) herbaceous vegetation. During autumn and winter, blue grouse preferred high elevation (>2285 m) stands of open (50% tree cover) conifer. Douglas-fir (*Pseudotsuga menziesii*) were preferred as winter roost trees. Sites selected in winter had significantly more Douglas-fir than those selected in autumn.

Blue grouse occur throughout western North America. Substantial work on this species has been conducted on Vancouver Island, British Columbia (e.g., Bendell and Elliott 1966, 1967, Fowle 1960, Zwickel and Bendell 1967, Lewis and Zwickel 1980). Blue grouse also have been studied throughout the Rocky Mountains (Marshall 1946, Caswell 1954, Heebner 1956, Blackford 1958, Boag 1966, Maestro 1971, Harju 1974, Weber 1975).

Most reports have concerned breeding behavior, with relatively little work being done on habitat requirements. Studies on blue grouse habitat typically have been qualitative in nature, relating grouse to general habitat categories (e.g., Marshall 1946, Caswell 1954, Heebner 1956, Bendell and Elliott 1966) or breeding habitat (Mussehl 1960, 1963, Maestro 1971, Martinka 1972, Weber 1975, Lewis 1981). Except for some analyses of male hooting sites (Martinka 1972, Lewis 1981), little quantitative information on blue grouse has been reported.

To adequately manage habitat for blue grouse, we must know their relationship to patterns of macro- and microhabitat characteristics. We previously described the macrohabitat relationships of blue grouse in southeastern Idaho (Stauffer and Peterson 1985). Here we address the microhabitat characteristics of blue grouse. Our objectives are to quantitatively describe habitats used by blue grouse for breeding and wintering and to compare characteristics of used habitats to available habitats.

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STUDY AREA AND METHODS

We examined blue grouse habitat relationships on the western portion (108,000 ha) of the Montpelier District of the Caribou National Forest, Bear River Range of the Wasatch Mountains in southeastern Idaho.

We classified the study area into eight relatively discrete vegetation types based on the dominant (according to density) tree and shrub species. Four open vegetation types (44% of the area) were most common at lower (<2130) elevations: sagebrush, mixed shrub, mountain mahogany, and bigtooth maple. Four forested vegetation types (56% of the area) were most common at mid and high

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elevation (>2130 m): aspen (*Populus tremuloides*), aspen/conifer mixed; dense conifer; and open conifer. We have described the floristic character of each vegetation type elsewhere (Stauffer and Peterson 1985).

We spent 1593 h (spring, 322 h; summer, 543 h; autumn, 296 h; winter, 432 h) searching for grouse from May 1979 through May 1981. Searching effort was distributed among the vegetation types in approximate proportion to their occurrence on the study area.

Each time a grouse (or group) was flushed, we used the location as the center of a 0.01 ha circular plot for which we recorded: percent of area within 40 m composed of coniferous or deciduous cover or open; canopy height and average height of herbaceous vegetation; number of woody stems <7 cm dbh in 2 perpendicular arm-width transects across the plot; number of trees by species within 6 dbh categories (7.0–15.0 cm, 15.1–23.0 cm, 23.1–38.0 cm, 38.1–53.0 cm, 53.1–69.0 cm, >69 cm dbh); and vegetation type.

We recorded 120 sets of plot data at random locations, 60 in the mixed shrub type and 60 in the maple vegetation type, to sample breeding habitat characteristics available to blue grouse.

We calculated means for data recorded in the 0.01 ha plots at grouse locations for various combinations of vegetation types and season to describe the characteristics of sites selected. For 38 winter roost trees, we measured a second set of plot data at the nearest potential roost tree that had no evidence of use. Additional data recorded at roost trees included tree species, diameter, and presence or absence of dwarf mistletoe (*Arceuthobium* spp.) infestation. We evaluated differences between used and unused sites with a paired t-test.

Prior to statistical analyses, all data were checked for normality, and those variables found to be nonnormal were transformed (log, square-root, or arc-sine) to achieve a more normal distribution.

Results and Discussion

Blue grouse used a variety of vegetation types (Table 1). The open vegetation types (sagebrush, mixed shrub, mountain mahogany, and maple) were used primarily during spring and summer. These types constitute breeding habitat. The dense and open conifer types were used most heavily in fall and winter, although the open conifer type also was used in spring and summer. These use patterns are similar to those recorded elsewhere for the intermountain region (Marshall 1946, Caswell 1954, Heebner 1956, Mussehl 1960, 1963, Boag 1966, Zwickel et al. 1968, Maestro 1971, Harju 1974, Weber 1975).

In spring and summer, junipers (*Juniperus* spp.) and bigtooth maple were most commonly associated with blue grouse (32% and 52% of 227 observations, respectively). We found Douglas-fir and subalpine fir (*Abies lasiocarpa*) at 73% and 53% of 191 fall and winter observations, respectively. Additionally, limber pine (*Pinus flexilis*) was noted at 47% of 57 winter Blue Grouse observations (Stauffer 1983). Common shrubs at 227 blue grouse locations in spring and summer were sagebrush (72% occurrence), snowberry (*Symphoricarpos* spp., 54%), bitterbrush (*Purshia tridentata*, 27%). Snowberry (72%), sagebrush (57%), chokecherry (*Prunus virginiana*, 28%), and snowbrush (*Ceanothus velutinus*, 19%) most commonly occurred at 134 fall observations (Stauffer 1983).

Characteristics of Breeding Habitat

Sites used by blue grouse (Table 2) differed among the four open vegetation types, based on 10 microhabitat characteristics [Multivariate Analysis of Variance (MANOVA, $P<001$)]. Although habitat characteristics differed among the vegetation types, used sites were all relatively open, with the highest cover of about 60% conifer and deciduous cover occurring in the mountain mahogany vegetation type. Use of open areas by blue grouse during spring and summer has been documented throughout their range (Marshall 1946, Caswell 1954, Mussehl 1960, 1963, Boag 1966, Zwickel et al. 1968, Martinka 1972, Harju 1974, Weber 1975, and Lewis 1981).

We found no difference between spring and summer sites used by blue grouse in sagebrush (Hotelling's T^2, $P>0.05$). The data reflected the openness of this habitat (Table 2), but the presence of some trees indicated that areas with at least some taller cover were pre-

TABLE 1. Distribution of blue grouse plot observations among the vegetation types studied; southeastern Idaho, 1979–1981.

Vegetation type	Percent of observations					
	Brood	Hooting	Spring	Summer	Autumn	Winter
Sagebrush	12	7	25	14	2	0
Mixed shrub	9	25	17	14	6	0
Mountain mahogany	0	21	7	9	11	0
Maple	36	45	34	35	2	0
Aspen	9	0	0	3	4	0
Aspen/conifer	3	0	4	1	8	0
Dense conifer	3	0	0	3	14	18
Open conifer	27	2	13	23	54	82
Number of observations	33	44	71	80	134	56

Spring and summer data exclude brood and hooting observations.

TABLE 2. Means of habitat characteristics recorded for 0.01 ha circular plots at blue grouse locations and random locations in open habitats in southeastern Idaho, 1979–1981.

Variable	Sagebrush	Mountain mahogany	Mixed shrub		Maple	
	$n = 33$	$n = 36$	Spring-autumn $n = 45$	Random obs. $n = 60$	Spring-summer $n = 84$	Random obs. $n = 60$
Coniferous cover (%)	2.6(0.6)[a]	4.0(1.1)	3.1(0.9)	* 0.2(0.1)	5.0(0.6)	5.8(0.8)
Deciduous cover (%)	8.4(1.7)	56.0(2.5)	26.4(2.8)	*15.4(2.0)	43.6(1.9)	49.4(3.1)
Open (%)	88.8(1.8)	40.0(2.4)	70.5(2.7)	*84.0(2.0)	51.4(1.8)	44.8(3.1)
Tree canopy cover (%)	8.2(3.3)	36.9(4.7)	8.3(2.4)	* 4.1(1.4)	23.8(2.5)	24.6(4.0)
Ground cover (%)	48.0(4.4)	42.6(3.9)	49.0(3.2)	*57.2(2.1)	56.5(2.5)	*78.6(2.1)
Canopy height (m)	1.3(0.2)	3.4(0.1)	2.0(0.2)	* 1.5(0.1)	3.5(0.2)	3.6(0.3)
Stems <7 cm dbh/ha	847(372)	2428(406)	7400(1590)	*4056(460)	4395(435)	4092(462)
Trees/ha	15(8)	352(50)	49(19)	40(19)	249(36)	305(60)
Coniferous trees/ha	12(6)	22(10)	2(2)	0	27(9)	18(7)
Deciduous trees/ha	3(3)	330(49)	47(19)	40(19)	222(35)	287(60)

[a]Standard error.
*Indicates a significant ($p<0.05$) difference based upon a t-test between the grouse observations and random observations in the vegetation type.

ferred. Mussehl (1963) and Weber (1975) noted that blue grouse often were found near clumps of trees in sagebrush stands.

Mountain mahogany was used spring through autumn and had the highest tree cover of the four open vegetation types (Table 2). Percent ground cover was the only characteristic that differed among spring, summer, and autumn observations and was highest in summer and autumn (47.8% and 56.0%, respectively) and lowest in spring (22.1%). Twenty-one percent of the hooting observations were in mountain mahogany, but no broods were found here.

Sites selected by blue grouse in the mixed shrub vegetation type did not differ among spring, summer, and autumn observations (MANOVA, $P>0.05$). However, microhabitat characteristics of sites used were different from a random sample of 60 sites in this type (Hotelling's T^2, $P<0.001$, Table 2). Percent coniferous and deciduous cover, percent tree canopy cover, and density of small stems were higher and percent open area and ground cover were lower at sites used by grouse than at random sites. Thus, blue grouse are selecting areas within the mixed shrub vegetation type with higher than average woody cover (see also Weber 1975).

We found differences in sites used between spring and summer by blue grouse in the maple vegetation type (Hotelling's T^2, $P < 0.01$). Percent coniferous cover and density of coniferous trees were higher and percent deciduous cover was lower at sites used in spring (spring $\bar{x} = 7.1\%$, 59/ha, and 37.6%, respectively; summer $\bar{x} = 3.4\%$, 2/ha, and 48.3%, respectively; $df = 79$ and $t = 3.2$, 4.1, and 2.3, respectively.) During spring, grouse often were associated with junipers in the maple type, which may provide cover prior to leafout of the deciduous trees. Weber (1975)

found that male blue grouse often were associated with junipers on breeding areas in Utah. Except for percent ground cover, which was lower at used sites, ($t = 6.1$, $P<0.01$), habitat characteristics were not different between random sites and those used in maple vegetation types (Table 2). Thus, blue grouse were not selecting for any particular characteristic of the maple vegetation type.

These open types provide suitable habitat for hooting by male blue grouse. Lewis (1981) reported tree cover of 6.6% and canopy height of 3.3 m at hooting sites on Vancouver Island. In Montana, Martinka (1972) found a tree crown cover of 30% at male display sites and Maestro (1971) noted that breeding blue grouse preferred areas of 41%–50% tree cover in Utah. These values are comparable to the characteristics of habitats where we found blue grouse breeding in southeastern Idaho (Table 2). The primary characteristic of hooting habitat is an interspersion of open areas with taller woody cover (Weber 1975).

Blue grouse broods selected areas with relatively high herbaceous cover. Within the maple vegetation type, mean height of herbaceous vegetation at 12 brood locations was 50.8 cm (SE = 4.0), which was higher than that of 35 other summer observations in maple ($\bar{x} = 38.0$ cm, SE = 3.4, $t = 2.16$, df = 45). In the open conifer vegetation type, mean herbaceous vegetation height at nine brood locations was 63.3 cm (SE = 14.8), whereas that for 19 other summer observations in open conifer was 31.0 cm (SE = 5.0, $t = 2.61$, df = 26). Sample sizes of broods in sagebrush (n = 4) and mixed shrub (n = 3) were not adequate for testing. Mussehl (1963) felt that herbaceous cover at least 50 cm tall, interspersed with bare ground to provide travel lanes, was the most important aspect of good blue grouse brood cover. Additionally, clumps of small trees and shrubs may enhance brood habitat by providing nesting sites and protection from predators (Mussehl 1960, 1963, Weber 1975) and may be particularly important in late summer when herbaceous cover becomes dessicated or is heavily grazed (Zwickel 1973).

These results indicate that a variety of vegetation types can be managed as blue grouse breeding habitat. No major differences between seasons within each type implies that maintaining habitat characteristics for each type within the levels reported in Table 2 should provide adequate conditions for breeding and brood rearing. Except for tall herbaceous cover for broods, different characteristics need not be provided for different stages of the breeding season. Although we did find some blue grouse breeding at high elevation, these areas probably are not as important for breeding as low elevation open habitats (Stauffer and Peterson 1985).

Characteristics of Coniferous Habitats

Blue grouse selected sites in dense conifer stands during fall and winter with about 65%–69% coniferous tree cover (Table 3). Since mean percent tree canopy cover at blue grouse locations in autumn was 45%, blue grouse selected the more open areas within dense conifer. Although tree density in dense conifer was similar at autumn and winter locations, significantly ($t = 2.15$, df = 27) more Douglas-fir were found at winter locations of blue grouse.

Blue grouse selected open conifer stands that had approximately a 50:50 conifer cover to open ratio. Caswell (1954) found that blue grouse selected open conifer slopes in winter with islands of subalpine and Douglas-fir. Percent tree canopy cover was relatively low in all seasons, averaging 32%–44% (Table 3).

Density of small stems at blue grouse locations in open conifer was lower for all seasons compared to those of other vegetation types (Tables 2 and 3). Densities of subalpine fir at grouse locations did not vary significantly among seasons, but Douglas-fir densities were higher ($t = 5.84$, df = 115) at winter locations than those for autumn (Table 3). In winter, this species is used for food and as roost sites (Marshall 1946).

Winter Roost Trees

We compared trees used as winter roosts and for feeding with those not used. Of 38 roost trees, 36 (95%) were Douglas-fir and one each (2.5%) were subalpine fir and Engelmann spruce (*Picea engelmannii*). Of 34 conifers recorded along randomly located transects in three wintering areas, 57% were Douglas-fir, 33% were subalpine fir, 5% were limber pine, 2% were Engelmann spruce, and 3% were lodgepole pine (*Pinus contorta*). Thus, Douglas-fir were preferred as roost trees.

TABLE 3. Mean vegetation characteristics recorded for 0.01 ha circular plots at blue grouse locations in the dense and open conifer vegetation types in southeastern Idaho, 1979–1981.

	Dense conifer		Open conifer			
Variable	Fall $n = 19$	Winter $n = 10$	Spring $n = 9$	Summer $n = 28$	Autumn $n = 71$	Winter $n = 46$
Coniferous cover (%)	68.7(2.7)[a]	65.5(2.7)	45.0(2.9)	48.9(2.2)	47.7(1.8)	44.2(1.8)
Deciduous cover (%)	1.8(.8)	1.7(1.0)	1.1(1.1)	3.0(1.3)	2.5(0.5)	4.8(1.3)
Open (%)	28.8(2.8)	33.6(3.1)	53.9(2.3)	48.0(2.1)	49.7(1.8)	50.9(2.0)
Tree canopy cover (%)	45.1(7.1)	—	33.7(9.6)(n=3)[b]	38.5(6.3)	31.6(4.1)(n=65)	40.5(8.5)(n=11)
Ground cover (%)	28.4(5.2)	—	14.4(8.3)	41.8(3.8)	32.4(2.5)	5.8(2.2)
Canopy height (m)	19.8(2.2)	22.8(1.2)	15.7(2.0)	13.8(1.4)	14.6(0.9)	18.8(1.1)
Stems < 7 cm dbh/ha	1026(247)	391(157)	134(71)	495(163)	1275(332)	291(77)
Trees/ha	426(126)	350(72)	256(67)	275(40)	294(40)	361(68)
Deciduous trees/ha	16(11)	0	0	18(9)	17(6)	15(10)
Subalpine fir/ha	195(72)	60(34)	33(33)	61(21)	140(33)	143(54)
Douglas-fir/ha	63(25)	180(57)	189(65)	154(38)	110(25)	193(30)
Lodgepole pine/ha	63(41)	50(40)	0	11(11)	7(4)	0

[a]Standard error.
[b]Where noted, sample size is smaller because the variable was not recorded for roost tree observations.

TABLE 4. Mean vegetation characteristics at 38 roost tree sites used by blue grouse and nearby unused sites; southeastern Idaho, 1979–1981.

Variable	Mean (SE)		Significance[a]
	Used	Not used	
Coniferous cover (%)	50.3(1.9)	44.5(2.1)	$p < 0.01$
Open (%)	45.2(1.9)	50.2(1.9)	$p < 0.01$
Canopy height (m)	21.5(0.9)	20.5(1.0)	$p > 0.20$
Trees/ha	321(32)	303(34)	$p > 0.20$
Trees 7–15 cm dbh/ha	100(24)	129(27)	$p > 0.20$
Trees 15–33 cm dbh/ha	97(23)	87(16)	$p > 0.20$
Trees > 33 cm dbh/ha	124(13)	87(10)	$p < 0.02$
Subalpine fir/ha	68(21)	87(26)	$p > 0.20$
Douglas-fir/ha	218(25)	179(22)	$p > 0.20$
Limber pine/ha	24(10)	24(10)	$p > 0.20$
Roost tree dbh (cm)	49.2(3.1)	42.8(2.4)	$p < 0.05$

[a]Represents the significance of a paired t-test for differences between used and unused trees for the variable.

A paired *t*-test revealed significant differences for four variables measured at used and unused trees (Table 4.) Coniferous cover was greater and percent of area open was less at used trees. Used trees had a larger dbh and the density of large (> 33 cm dbh) trees was higher at used trees, as measured within circular plots (Table 4). Thus, within open conifer stands, blue grouse were selecting trees for roosting and feeding that were in denser clumps and were larger than trees not used. Roost trees often were in clumps rather than solitary. Although not investigated here, nutritional differences in the needles of different trees might influence roost and feeding tree selection, as has been found for spruce grouse (*Dendragapus canadensis*, Ellison 1976).

Blue grouse appeared to prefer large Douglas-fir that had dense foliage. The dense foliage may provide protection from predators and weather, which often is harsh at high elevations in winter.

Maintenance of open, high elevation stands of conifers, especially those containing Douglas-fir, should provide adequate winter habitat for blue grouse. Such stands have low commercial value; thus winter habitat of blue grouse probably is not threatened in southeastern Idaho.

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